Measurement of mechanical quality factors at 20 GHz in planar opto-mechanical microcavities

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The prospects and possibilities of strong coupling of light with mechanical vibrations in nanomechanical systems have stimulated a fast growing field of research in recent years. Pushing the frequency of the mechanical vibrations into the higher GHz regime requires however new methods to accurately measure and characterize the mechanical quality factors in the respective nanoresonators. Measurements in the time domain conducted by usual pump-probe schemes become unreliable when the lifetimes exceed several nanoseconds. Here, we present a novel method based on high frequency repetition rate lasers operating at 10 GHz which overcomes the aforementioned drawbacks and gives direct access to the systems resonance behavior and thus the mechanical quality factor. This is achieved by matching the laser repetition rate to a subharmonic of the systems mechanical vibration and subsequently measure the resonance behaviour by sweeping the laser repetition rate. The system performance is demonstrated with measurements of planar opto-mechanical microcavities with mechanical eigenfrequencies at 20GHz.

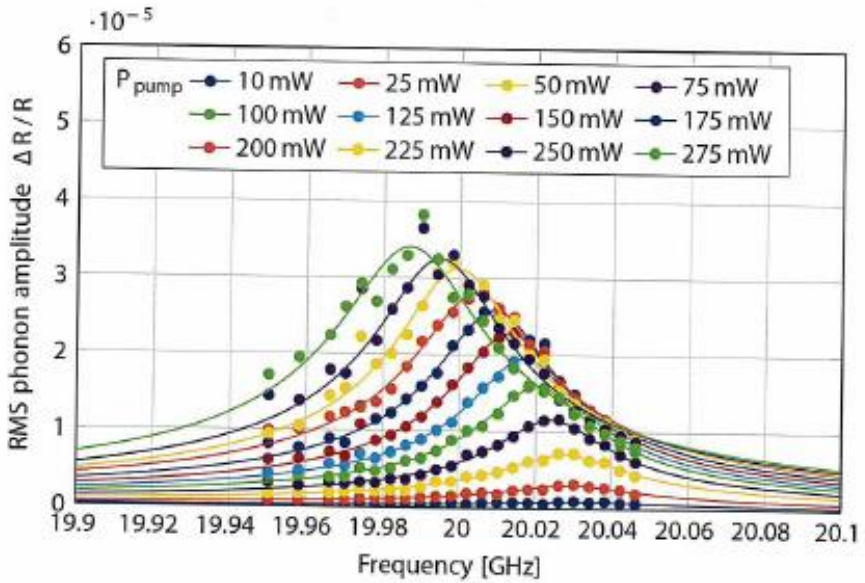

Fig. 1: Amplitude of the mechanical eigenfrequency as a function of the laser reptition rate. The color coding depicts the respective pump power.